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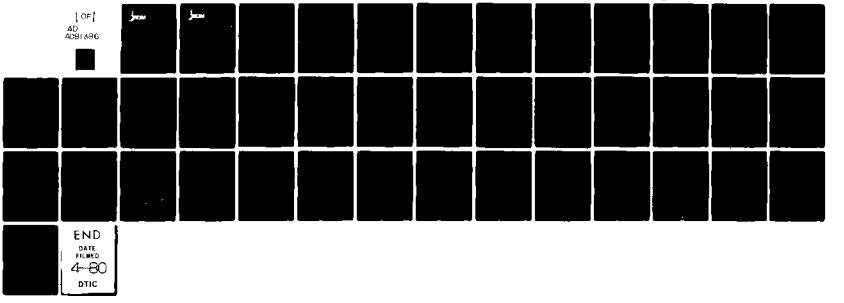

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22 October 1979

Technical Report No. BDM/M-014-79

Contract No. DAAK 40-78-C-0195

EXECUTIVE SUMMARY OF THE NATIONAL TRAINING CENTER PLANNING SUPPORT

Submitted to: The TRADOC Systems Manager for NTC, U.S. Army Training and Doctrine Command, Fort Monroe, Virginia.

411162

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LIST OF FIGURES

OVERVIEW

Overview

NTC PLANNING SUPPORT - TASK SUMMARY

> This Executive Summary Report presents the results of selected tasks of the Phase I Planning Support.

The tasks performed are shown in Figure 1. This summary presents the results of Subtasks 1.2, 1.3, and 1.4 of Task 1.

Task 2 was performed for and reported to the Defense Advanced Research Projects Agency (DARPA). Subtasks 1.2, 1.3, and 1.4 were performed for the NTC TSM.

TASK SUMMARY

TASK 1 - PHASE I PLANNING SUPPORT

SUBTASK 1.1	DEVELOP TRAINING AND TRAINING DEVELOPMENTS CONCEPTS - PERFORMED AND REPORTED TO CATRADA
SUBTASK 1.2	PROVIDE SYSTEMS INTEGRATION SUPPORT
SUBTASK 1.3	DEVELOP A MANAGEMENT CONCEPT
SUBTASK 1.4	INVESTIGATION OF PHASE I OPPORTUNITIES TO BE DERIVED FROM NTC 1A TEST

TASK 2 - PHASE II PLANNING SUPPORT - PERFORMED AND REPORTED TO DARPA

SUBTASK 2.1	REFINE SYSTEM ARCHITECTURE
SUBTASK 2.2	DEVELOP BROCHURE FOR INDUSTRY SYMPOSIUM
SUBTASK 2.3	PROVIDE FOLLOW-UP TECHNICAL ASSSESSMENT

Figure 1. Summary of NTC Planning Support Tasks

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SYSTEMS INTEGRATION SUPPORT

- NTC Phase I Development Options - Summary
- Principal NTC System Components
- Design and Systems Integration for Phase I
- Representative NTC Phase I Configuration
- Command Post Exercises/Notional Battalions
- Training Analysis and Feedback Requirements
- Field Data Collection - Electronic Clipboard
- Field Data Collection - Manual Data Forms

Systems Integration Support

NTC PHASE I DEVELOPMENT OPTIONS - SUMMARY

For NTC Phase I integration planning purposes, four representative development approaches were considered.

NTC Phase I will be developed under contract with industry. To provide a basis for assessing alternative approaches, four representative development approaches for NTC Phase I have been published. Details of these were provided in earlier reports submitted to TRADOC.

Option A, Limited Phase I - This plan limits the number of RMS-instrumented players to 120 in Phase I. The PLAFIRE concept would be introduced in the fourth quarter of FY 82, three to four years earlier than currently planned.

This plan avoids heavy reliance on RMS instrumentation and minimizes the development effort for Phase I. This is accomplished by using CDEC's TASVAL software, which can support 120 players, directly on NTC computers. Development effort and schedule risk are avoided by not attempting to upgrade the RMS system to 450 players. An alternative to the CDEC TASVAL software is the OSD DDT&E SEL-86 software.

Option B, Full Phase I Instrumentation - This plan provides for fielding 450 RMS-instrumented players in Phase I, followed by early introduction of PLAFIRE in fourth quarter FY 82.

Option C, Full Phase I Instrumentation, PLAFIRE Delayed - This plan provides the same option as B but delays PLAFIRE.

Options A, B and C all require major investments in A-Stations for RMS coverage. Options B and C require 330 more B-Units than does Option A, not counting additional spares. This increase in B-Units would cost on the order of eight million dollars. Further, both Option B and C involve substantially more development effort than Option A. Further, according to CDEC engineering estimates, 55 A-Stations are needed for minimum coverage of the 10KM by 10KM playing area. For Fort Irwin, approximately 50KM by 50KM, this would require upwards of 275 A-Stations at a cost of over $20 million, exclusive of B-Units.

Option D, PLAFIRE - This plan provides for elimination of Phase I, shifting the IOC to fourth quarter of FY 82 and immediate development of PLAFIRE.

In this approach, TRADOC does not invest resources in the development and implementation of two operational systems for two separate phases. All resources are concentrated on the modern PLAFIRE instrumentation.

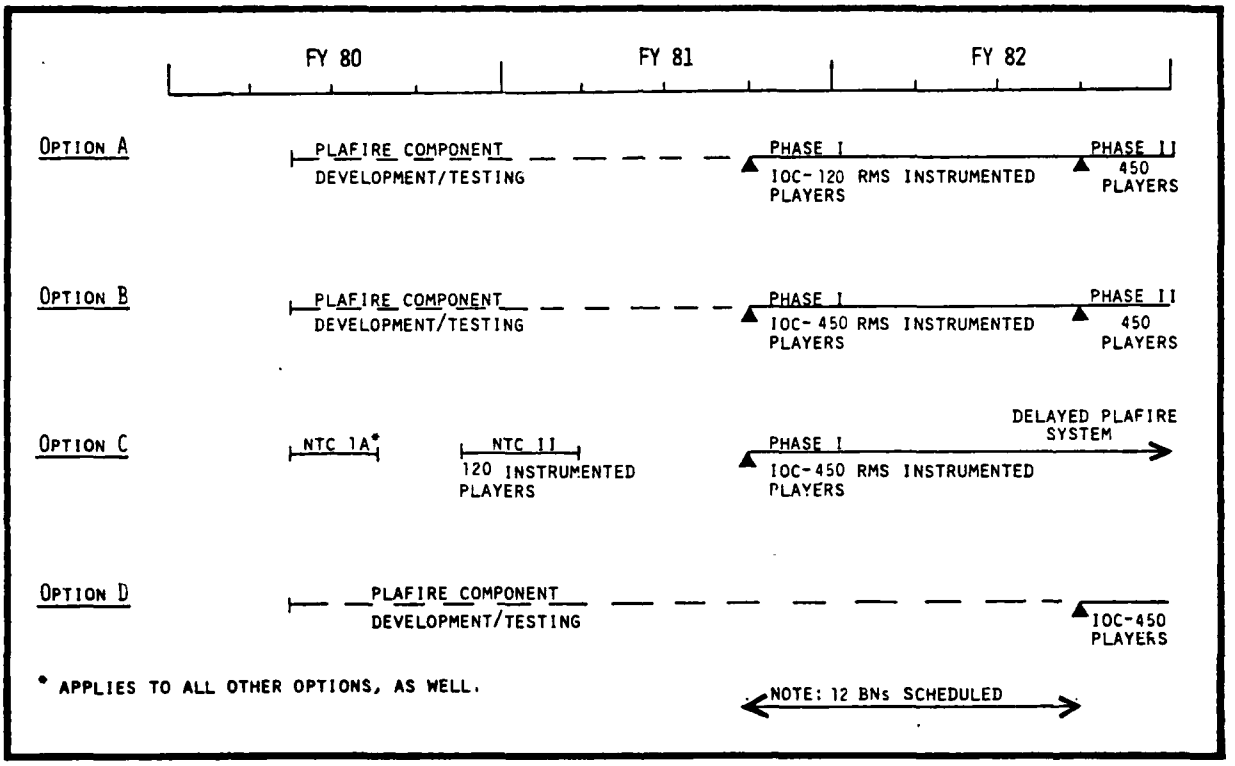


Figure 2. Comparison of NTC Options

Systems Integration Support

PRINCIPAL NTC SYSTEM COMPONENTS

> There are seven principal components which must be developed and integrated to establish the total NTC system for Phase I.

The NTC system components needed for Phase I are shown in Figure 3.

Three Instrumentation Subsystem Components - The instrumentation system required for this role has three highly interrelated components:

- Force-on-force engagement simulation instrumentation
- Live fire instrumentation
- Data processing and display systems.

This instrumentation will do the following:

- Record position location
- Simulate and record engagement events
- Transmit real-time control to the field
- Provide data processing and displays for training analysis and feedback (TAF).

Notional Battalion - CPXs or notional battalions will support training of the Brigade as well as the additional Battalion staffs.

OPFOR - The OPFOR will represent a Soviet motorized rifle regiment. The tactics and techniques employed must be those of the Soviets.

Exercise Monitor and Control (EMC) - The EMC is required for many operational functions essential to effective operations:

- Conduct automated instrumentation countdown
- Establish software initialization
- Control OPFOR
- Range safety
- Control electromagnetic emissions
- Administrative kill of players as required
- Check status of instrumentation and software during operations
- Control CCTV and voice recording instrumentation.

Training Analysis and Feedback - TAF post-exercise training will be conducted in After Action Reviews (AAR) which will emphasize training by analysis and feedback of the exercise data.

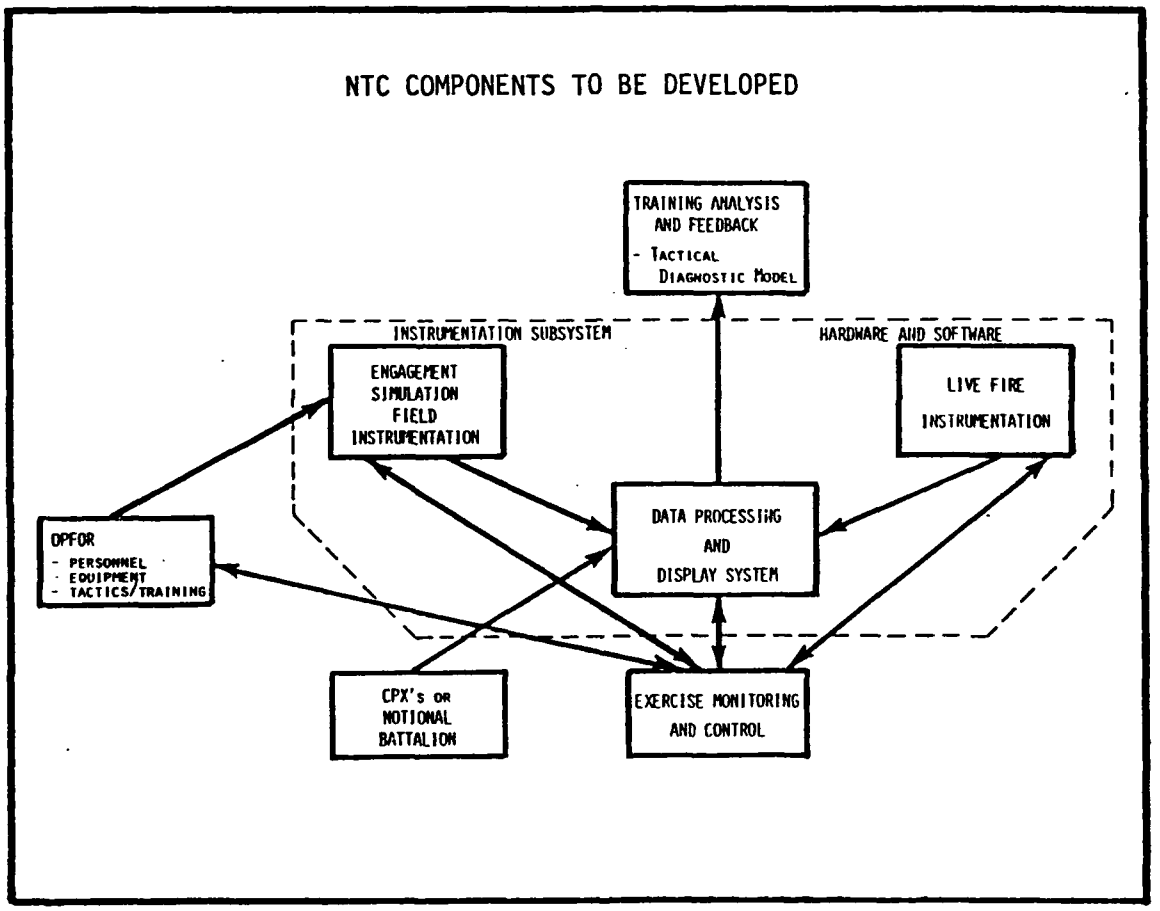


Figure 3. Principal Components to be Developed and Integrated to Establish NTC System

Systems Integration Support

DESIGN AND SYSTEMS INTEGRATION FOR PHASE I

> The principal components of the NTC system functionally interact and the NTC Phase I system must be designed as an integrated system.

Integrated System Design - The seven principal components of the NTC have been organized into the total system presented in detail in Figure 4. This figure illustrates the complex relationship which exists among components and emphasizes the importance which must be directed to an integrated approach to planning and implementation of both hardware and software.

PL System/MILES Integration - The position location system operations and MILES engagement simulation will be integrated in Phase I. Figure 4 shows this for the case of the RMS system. The RMS control, command generator, and range/event data collection are shown as key functions under REAL-TIME-SOFTWARE AND DISPLAY. Alternative PL systems may be used.

CDEC PL/MILES Backup - Many of the functions and functional elements presented in Figure 4 are already in operation at CDEC. The CDEC system, developed for the TASVAL test, can handle up to 120 instrumented players. CDEC also uses its own Laser Direct Fire System (LDFS) for engagement simulation. Engagement computation of P_K and assessment of casualties is conducted in the central computer. The LDFS provides an excellent backup for MILES in Phase I.

CDEC has already conducted training analysis and feedback exercises for TIE, and much of the CDEC software and computer hardware for graphical display is applicable to NTC TAF functions. Under CDEC's participation in NTC 1A Stage I, CDEC will be developing the additional software necessary to support TAF development and instrumentation.

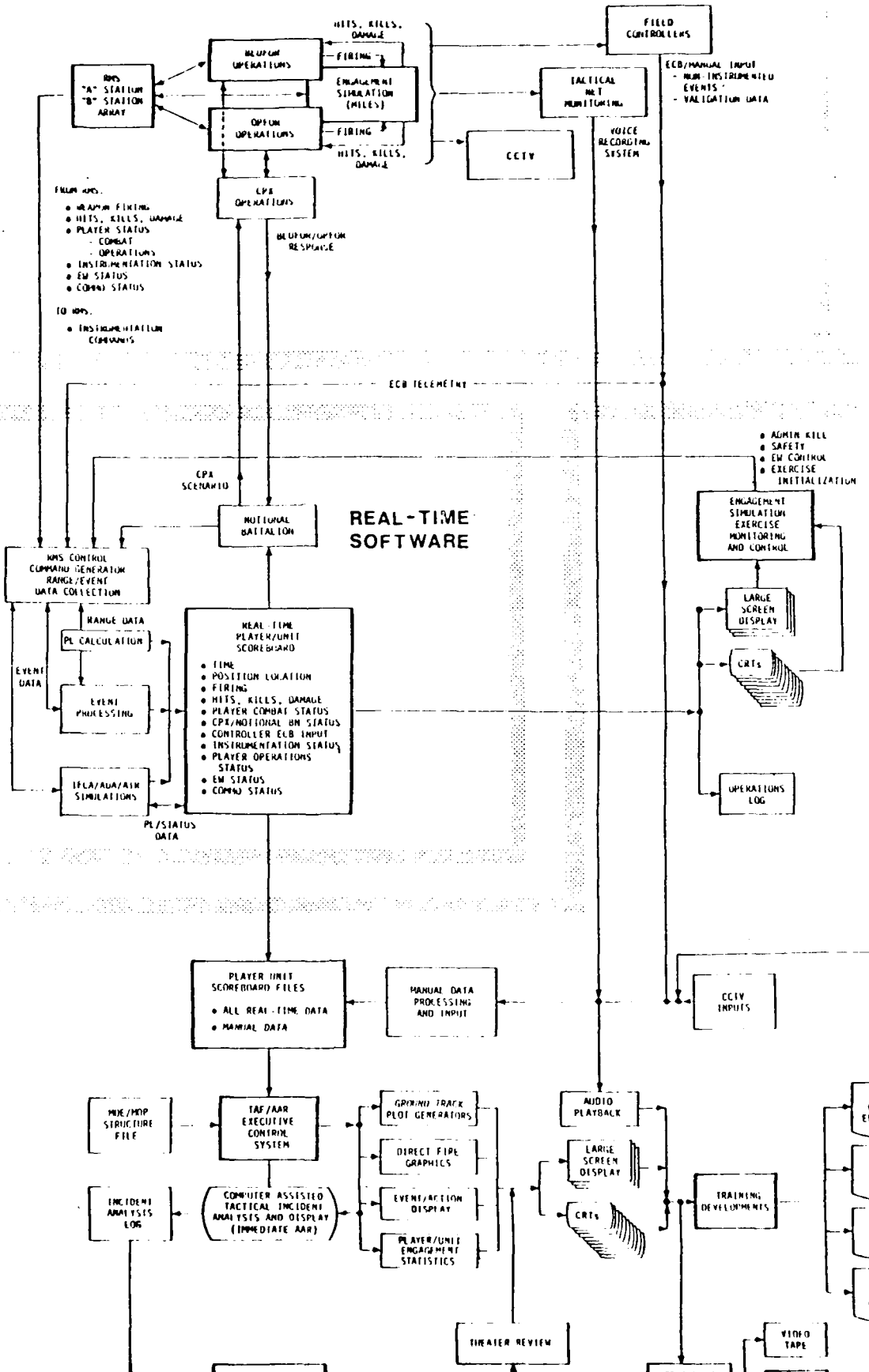
Maximum Effectiveness - The system design provides for all required real-time EMC and TAF functions, operation of field instrumentation and the interaction of the operating system with NTC management. The design of the system maximizes transparency and realism for the players through:

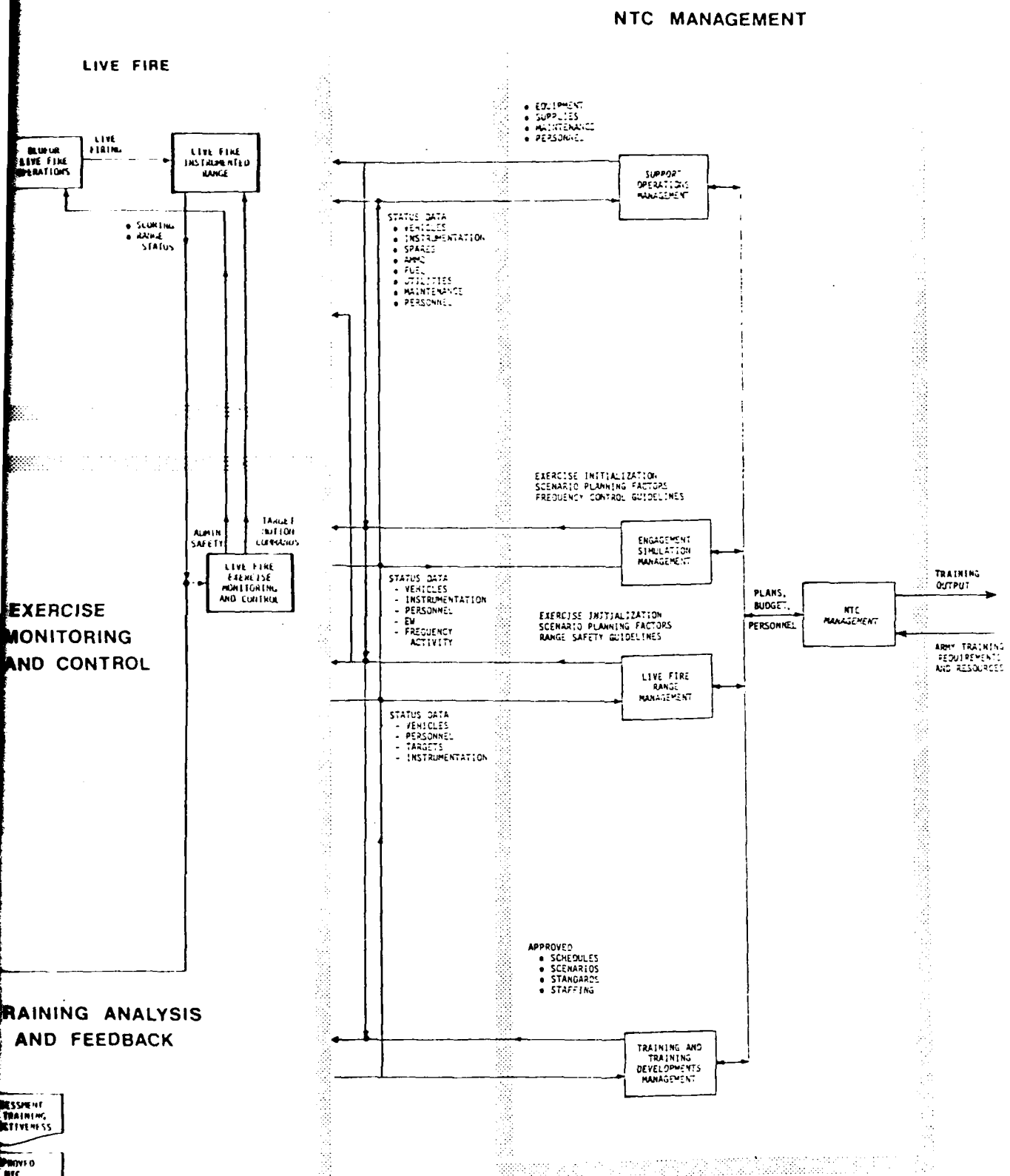
- Lack of intrusion of instrumentation into player activities; and
- Inclusion of all major facets of combined arms operations.

The interaction between operations and management shown in the figure is essential for successful training. The NTC operation is so complex that failure to coordinate plans, maintain equipment or instrumentation, or provide adequate supplies will seriously disrupt training.

FIELD OPERATIONS

ENGAGEMENT SIMULATION




NTC MANAGEMENT
LIVE FIRE
LIVE FIRE INSTRUMENTED RANGE
LIVE FIRE EXERCISE MONITORING AND CONTROL
EXERCISE MONITORING AND CONTROL
SUPPORT OPERATIONS MANAGEMENT
ENGAGEMENT SIMULATION MANAGEMENT
LIVE FIRE RANGE MANAGEMENT
TRAINING AND TRAINING DEVELOPMENTS MANAGEMENT
NTC MANAGEMENT
PLANS, BUDGET, PERSONNEL
TRAINING OUTPUT
ARMY TRAINING REQUIREMENTS AND RESOURCES
EQUIPMENT
SUPPLIES
MAINTENANCE
PERSONNEL
STATUS DATA
VEHICLES
INSTRUMENTATION
SPARES
AMMO
FUEL
UTILITIES
MAINTENANCE
PERSONNEL
EXERCISE INITIALIZATION
SCENARIO PLANNING FACTORS
FREQUENCY CONTROL GUIDELINES
STATUS DATA
VEHICLES
INSTRUMENTATION
PERSONNEL
EW
FREQUENCY ACTIVITY
EXERCISE INITIALIZATION
SCENARIO PLANNING FACTORS
RANGE SAFETY GUIDELINES
STATUS DATA
VEHICLES
PERSONNEL
TARGETS
INSTRUMENTATION
APPROVED
SCHEDULES
SCENARIOS
STANDARDS
STAFFING
TRAINING ANALYSIS AND FEEDBACK
RESULTS
PROPOSED STANDARDS
SCENARIO DESIGNS
TAF METHODOLOGY
TRAINING EFFECTIVENESS
REQUIREMENTS FOR PERSONNEL
REQUIREMENTS FOR COMPUTER/SOFTWARE/TRAINING MATERIALS
SUPPLIES
MAINTENANCE

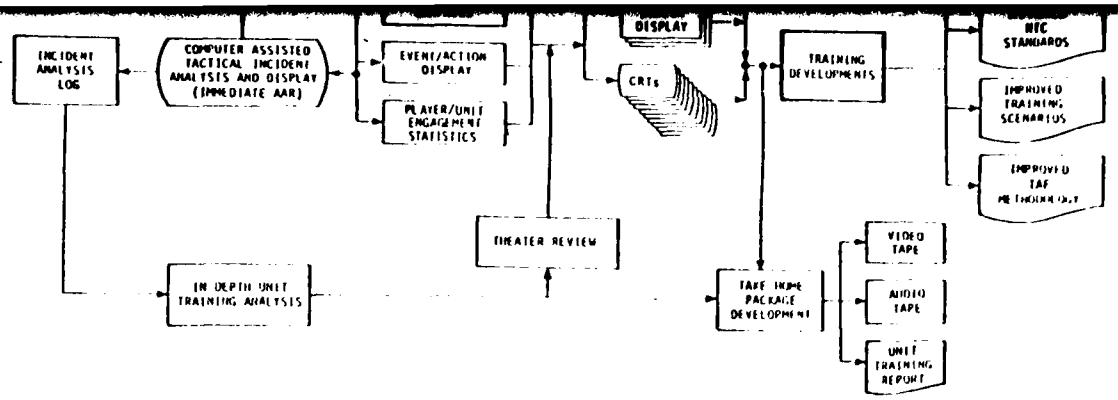


Figure 4. NTC System Concept

TRAINING ANALYSIS AND FEEDBACK

- RESULTS
  - PROPOSED STANDARDS
  - SCENARIO DESIGNS
  - TAF METHODOLOGY
  - TRAINING EFFECTIVENESS
- REQUIREMENTS FOR PERSONNEL
- REQUIREMENTS FOR COMPUTER/ SOFTWARE/TRAINING MATERIALS
  - SUPPLIES
  - MAINTENANCE

11/12

ncept - Phase I

4

Representative NTC Phase I Configuration

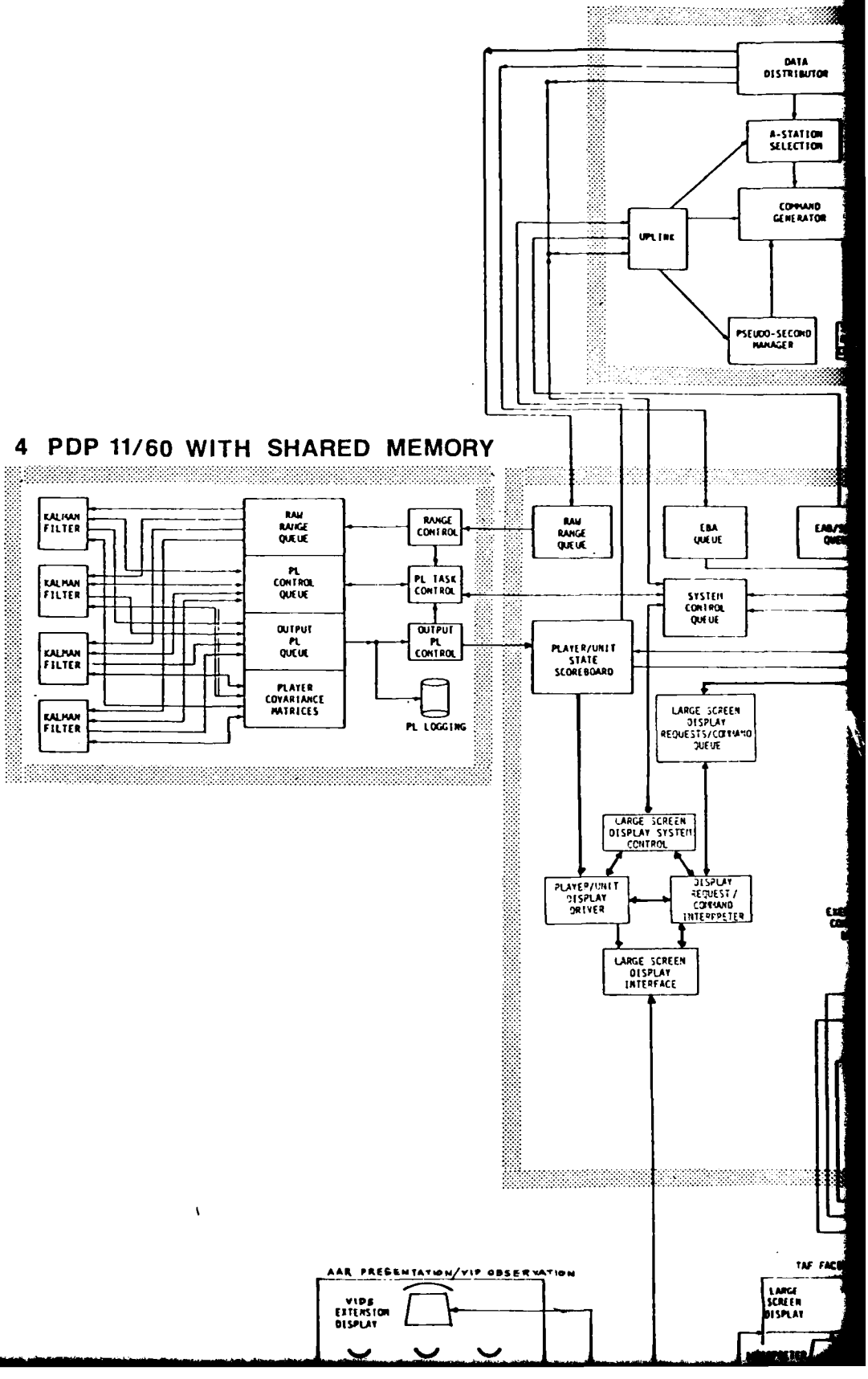
Systems Integration Support

REPRESENTATIVE NTC PHASE I COMPUTER CONFIGURATION

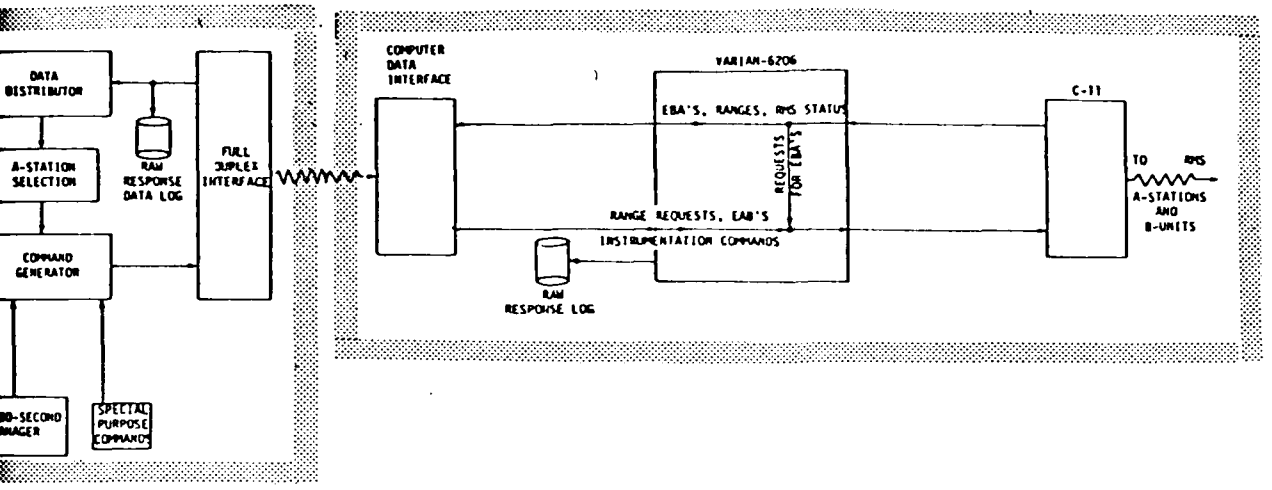
A representative computer hardware system was developed for NTC Phase I planning.

Representative NTC Phase I Configuration - A representative computer hardware configuration to support NTC Phase I consists of equipment compatible with the currently operational CDEC/TRADOC MCS software. The proposed configuration is centered around the Digital Equipment Corporation's VAX-77/780 computer. In addition to the VAX, current NTC parameters suggest that five additional machines such as the PDP 11/60 will be required to support various functions. These machines, especially the VAX system, were designed to be directly upward compatible with the hardware and software currently in use at CDEC.

NTC PHASE I DETAILED COMPUTER S

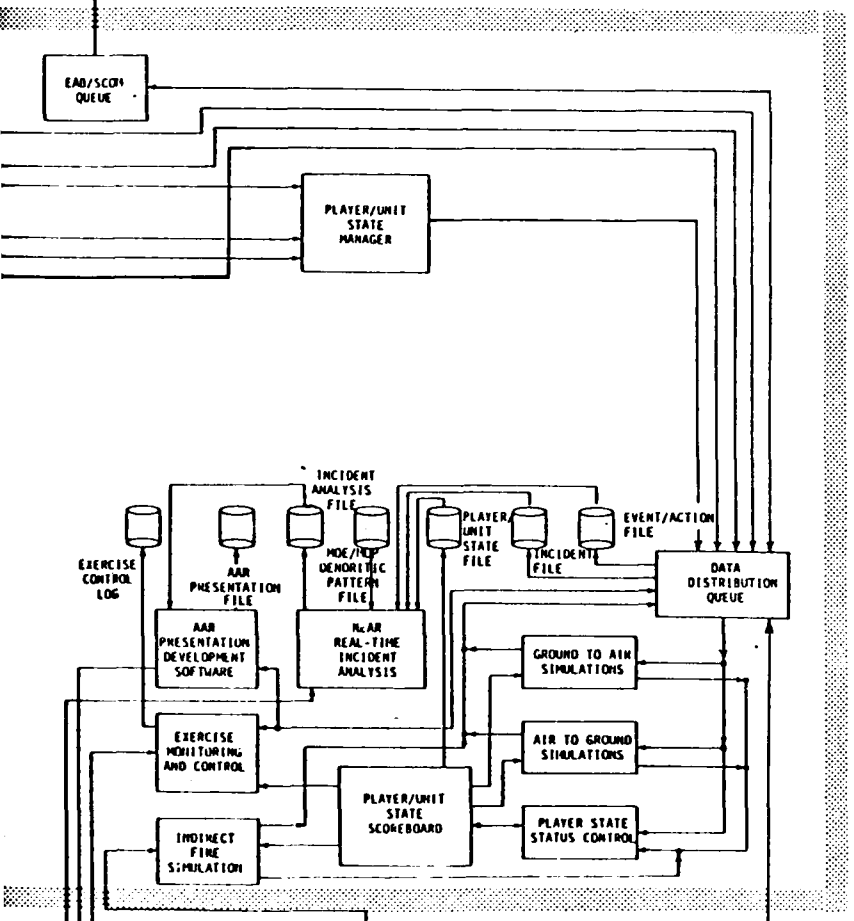


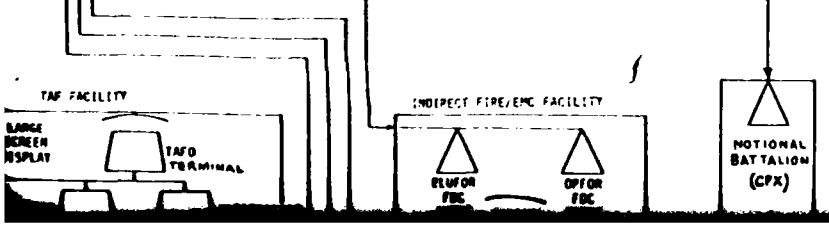
ER SYSTEM – FUNCTIONS AND DATA FLOWS



PDP 11/60

VAX 11/780





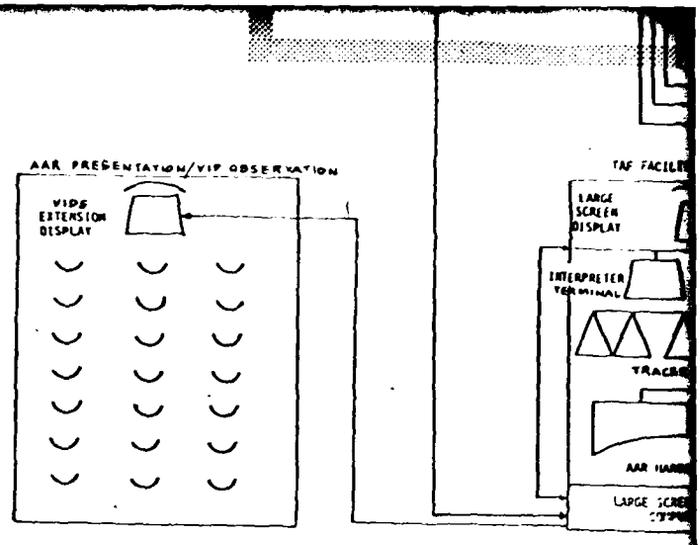
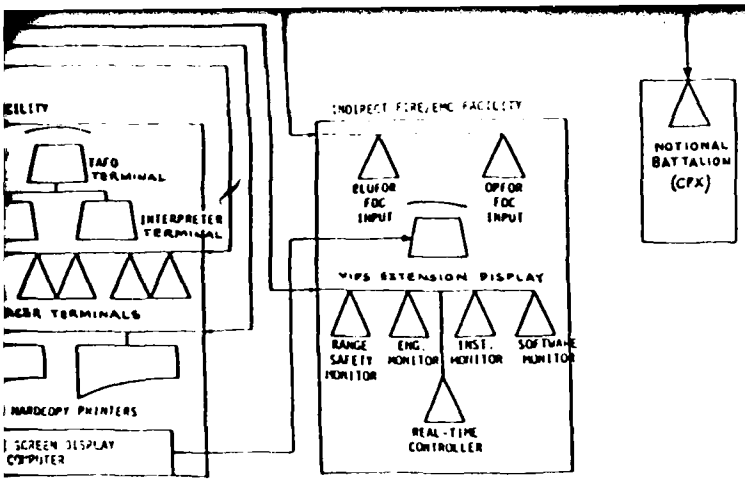


Figure 5. Representative NTC Ph



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Phase I Detailed Computer System

Command Post Exercises/Notional Battalions

Systems Integration Support

COMMAND POST EXERCISES/NOTIONAL BATTALIONS

> Command post exercise (CPX) techniques will effectively generate activities of notional BN CPs and other notional elements.

Brigade Headquarters (BDE HQ) - Realism in exercising BN command and control requires representation of BDE HQ operations. There are four steps to do this:

- Establish realistic BDE HQS for NTC exercises.
- Provide tactical communication interactions with "live" battalion.
- Add interactions with "other" battalions to create realistic combat activity environment in BDE HQs.
- Generate interactions with "other" battalions by simulating BN CP activities.

For the BN TF commander and staff, the interaction with BDE HQ is essential. Interactions with "other" BN TF can be handled in the play of the BDE HQ as shown in Figure 6. Division HQ will be simulated to generate a normal command relationship with BDE HQ.

Support Functions - Elements directly supporting the BN TF, such as the air defense platoon and the artillery battery, will be live units. The associated headquarters of these elements will be notional.

CPX Techniques - There are two approaches to generating realistic command relationships with notional units:

- CPX techniques are implemented through written scenarios under controller direction. They are realistic, but limited in the real-time variations that can be made to the basic scenarios. Minimum resources are required.
- Computer simulations of BN TF action can be done in a manner similar to CATTS. The realism is greater than for CPX, but is gained at great cost in development and operation.

The CPX approach meets the basic requirement for realism. Computer simulations should be added when they have been effectively developed to tie into the NTC operation.

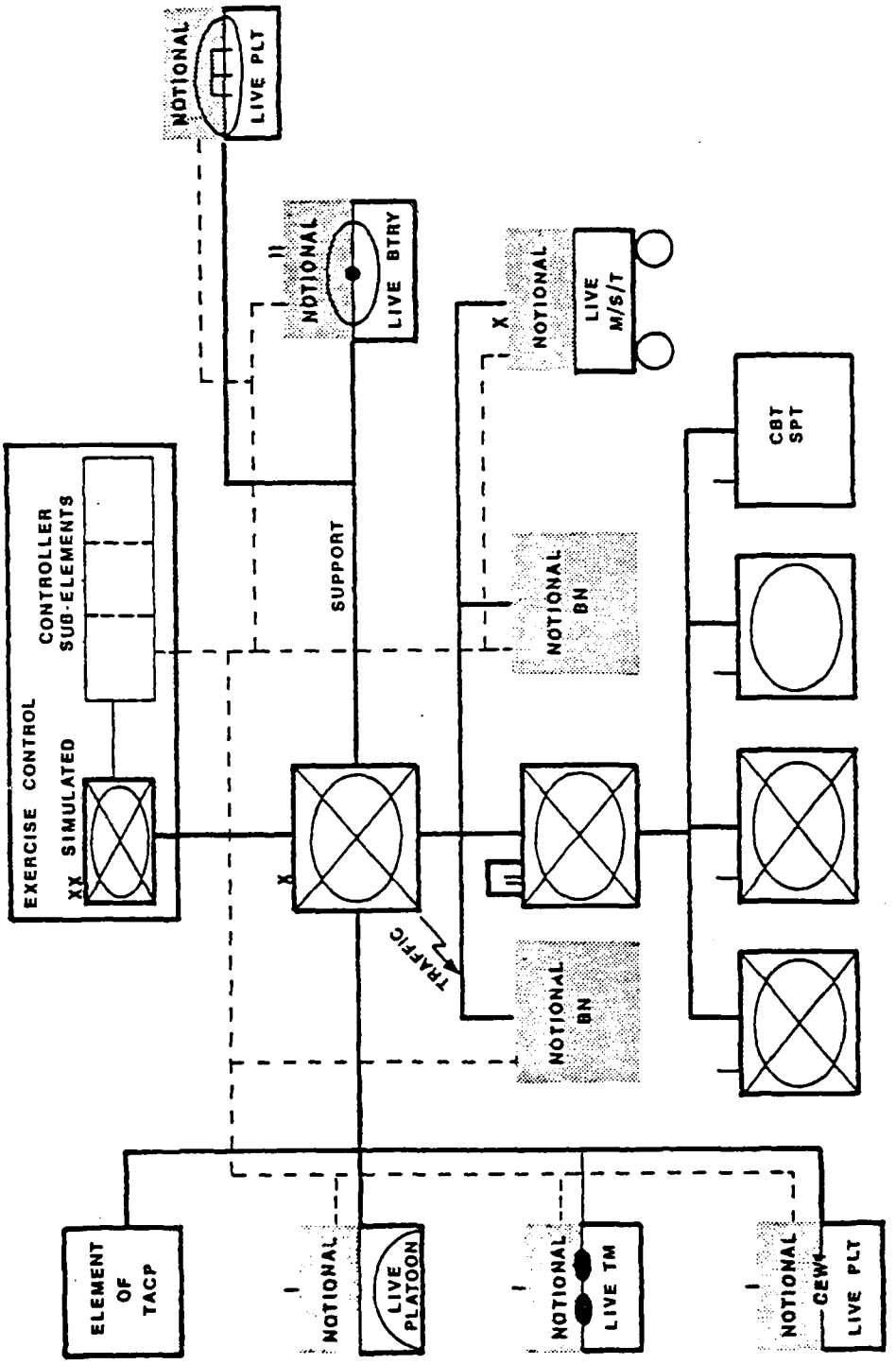

Figure 6. A Combination of Live and Notional Components Will Be Exercised

Systems Integration Support

TRAINING ANALYSIS AND FEEDBACK REQUIREMENTS

> Training analysis and feedback (TAF) will address BN TF performance with a variety of data and displays.

Data Requirements - Analysis of the performance of a combined arms BN TF is complex because of the large number of functions that are performed by the unit. Data and information display requirements are determined by the various combat functions, such as maneuver unit, fire support, air defense, and communications; and levels of combat activity in terms of execution, control, coordination, and planning.

Figure 7 shows the components of the BN TF functions for which data are required for training analysis and feedback. The data requirements vary between the execution, control, and coordination levels. Plans developed by BN HQ staff prior to an exercise will be evaluated using the maps and messages generated by the staff.

Control and Coordination Emphasis - The BN TF is primarily a control and coordination unit, with execution of plans carried out by subordinate elements. Execution level data such as position location and real-time casualty assessments describe how well the BN TF performs in a mission. The instrumented engagement simulation data will be essential to diagnosing performance.

Tactical radio net monitoring and BN HQ and CO HQ controllers will provide a significant amount of information at the control and coordination level.

Live Fire Feedback - The live fire exercises, at least initially, will be less sophisticated in terms of instrumentation than the engagement simulation exercises. Data will be available on target scores and supplemented with controller inputs to provide performance assessments of the BN TF.

After Action Reviews of the Data - The instrumented data will be displayed as ground tracks, casualties by unit, pairings between firers and targets, player/unit status, and other measures. These data will be supplemented by video, tactical net voice recordings, and controller inputs through electronic clipboards and manual information.

The Training Analysis and Feedback (TAF) staff will monitor much of the data in real time and develop and conduct structured After Action Reviews (AAR). A take-home package will be provided to support follow-on training.

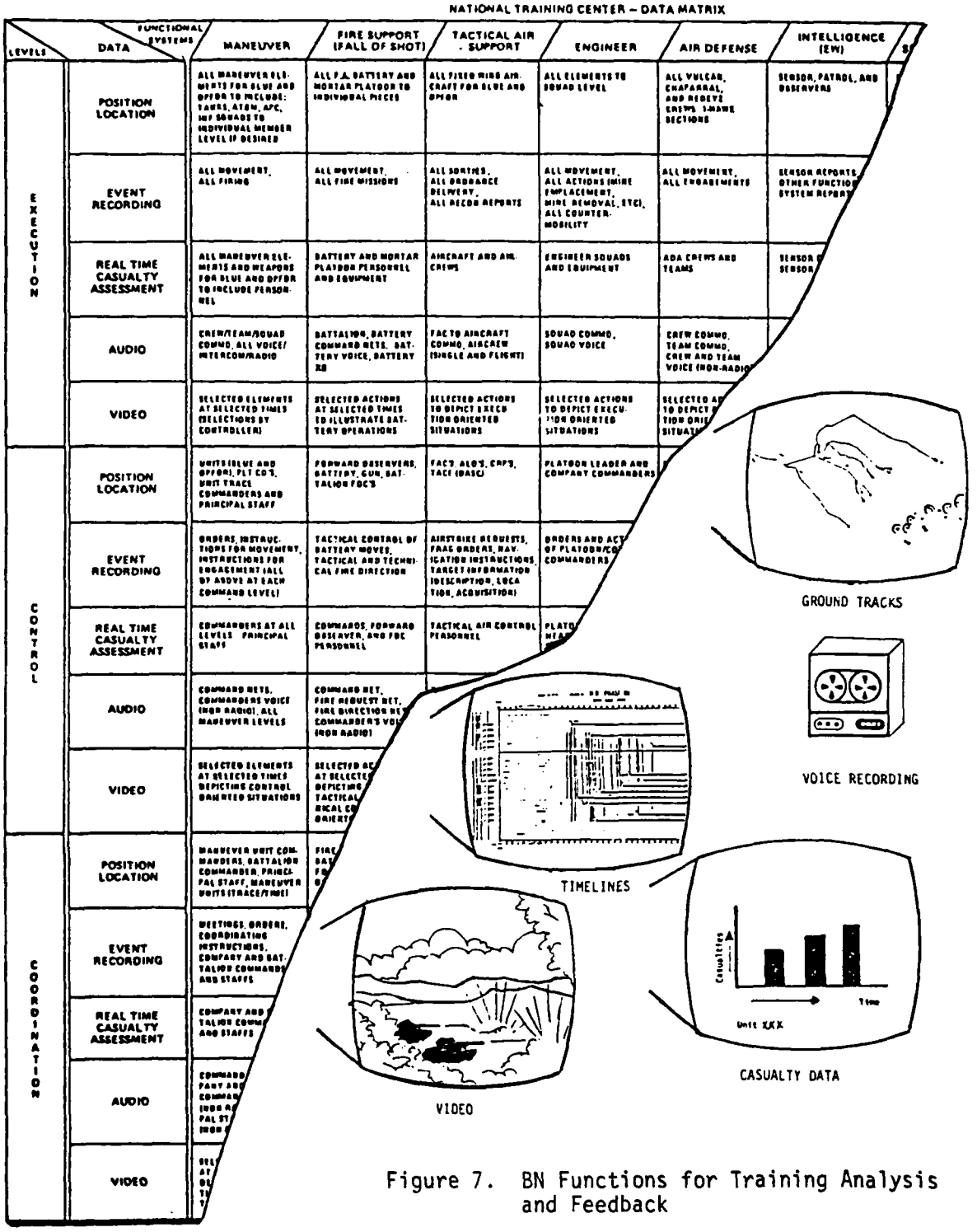

Figure 7. BN Functions for Training Analysis and Feedback

Systems Integration Support

FIELD DATA COLLECTION - ELECTRONIC CLIPBOARD

> Manual collection is required for data not suitable for direct instrumentation and provides redundancy for the instrumented system.

Manual Collection - Manually collected data provide human insight into key events and anomalous occurrences. Extremely important, too, is the fact that if the automated data collection system fails, manually collected data will be the only data available for analysis and evaluation. These points are summarized in Figure 8.

Two means of manual data collection are available for use:

- Electronic Clipboard (ECB) with output fed to digital recorder on data collector, or telemetered to central location; and
- Manual data forms.

Both may be used.

ECB - Devices are similar to a hand-held calculator. Each button can be designated to have a specific meaning, and each entry can be time tagged. Use of ECBs in EW/CAS tests have shown accuracies of ± 2 seconds in recording events with random errors occasionally as large as ± 15 seconds.

Figure 8 provides a detailed breakdown of ECB equipment and costs which would satisfy NTC requirements for 50 controllers.

Manual Data Collection

- Incorporates expert field judgment into the training feedback
- Provides redundancy for the instrumented data collection.

Component	Number Required	Each	Total
ECB	50	$2,000	$100,000
Memodyne Record Play Back Unit	1	2,000	2,000
Modem Interface Repeater (MIR-4)	1	250	250
Modem Eliminator ME-81	1	250	250
A.B. EIA Switch	1	145	145
829 KSR Terminal	1	2,470	2,470
A, B, C, D, Switches	6	335	2,010
TOTAL			$107,125

Figure 8. ECB Data Collection and Processing System

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MANAGEMENT CONCEPT

- NTC Management Staff
- Field Instrumentation Maintenance

Management Concept

NTC MANAGEMENT STAFF

> A total of approximately 75 personnel are required for the NTC Management Staff.

Figure 9 delineates the organization and quantities of personnel required for the NTC Management Staff.

Training and operations will be accomplished by the elements of the Command in accordance with standing policies and procedures of the NTC Operations and Training Directorate.

Interface between NTC and the USAIS (OPFOR doctrine, OPTEPs, and OPFORMS) will be thorugh the NTC Training Division. Training analysis and feedback from the TAF staff will be through the Training Division's BLUFOR and OPFOR Branches.

The Personnel and Fiscal Directorate will provide support as required to supplement organic support.

Logistics and Maintenance will provide for the acquisition, receipt, storage, issue, turn-in, maintenance, and property disposal for all elements except the Instrumentation Directorate (not shown in Figure 9).

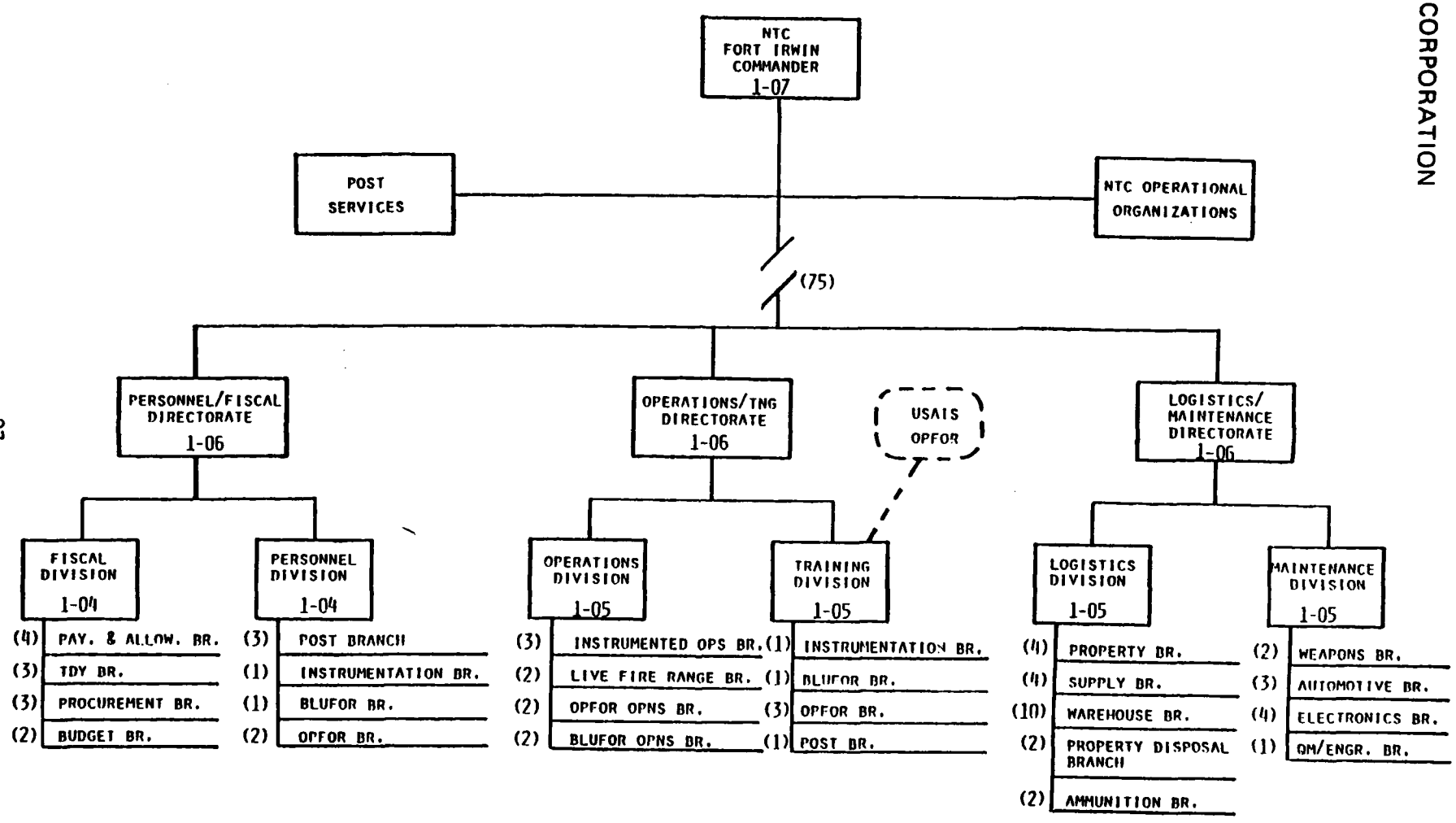


Figure 9. NTC Management Staff

Management Concept

FIELD INSTRUMENTATION MAINTENANCE

> Approximately 256 personnel are required to support the maintenance of 450 instrumented player fielded at the NTC.

Figure 10 shows the instrumentation maintenance organization necessary to support the NTC.

The total number and types of personnel are based on CDEC's experience for TASVAL and an average instrumentation reliability of about 1000 hours Mean Time Between Failure (MTBF). The weakest link was the RMS B-Unit (Micro-B) which had an MTBF of 466 hours.

The number of personnel has been categorized as follows:

- Managers - 6
- Engineers - 23 (including 2 supervisors)
- Programmers - 25 (including 3 supervisors)
- Technicians - 164 (including 7 supervisors)
- Data Analysts - 6
- Other Support - 32 (typists, Q/C inspectors, logistics, etc.)

TOTAL 256

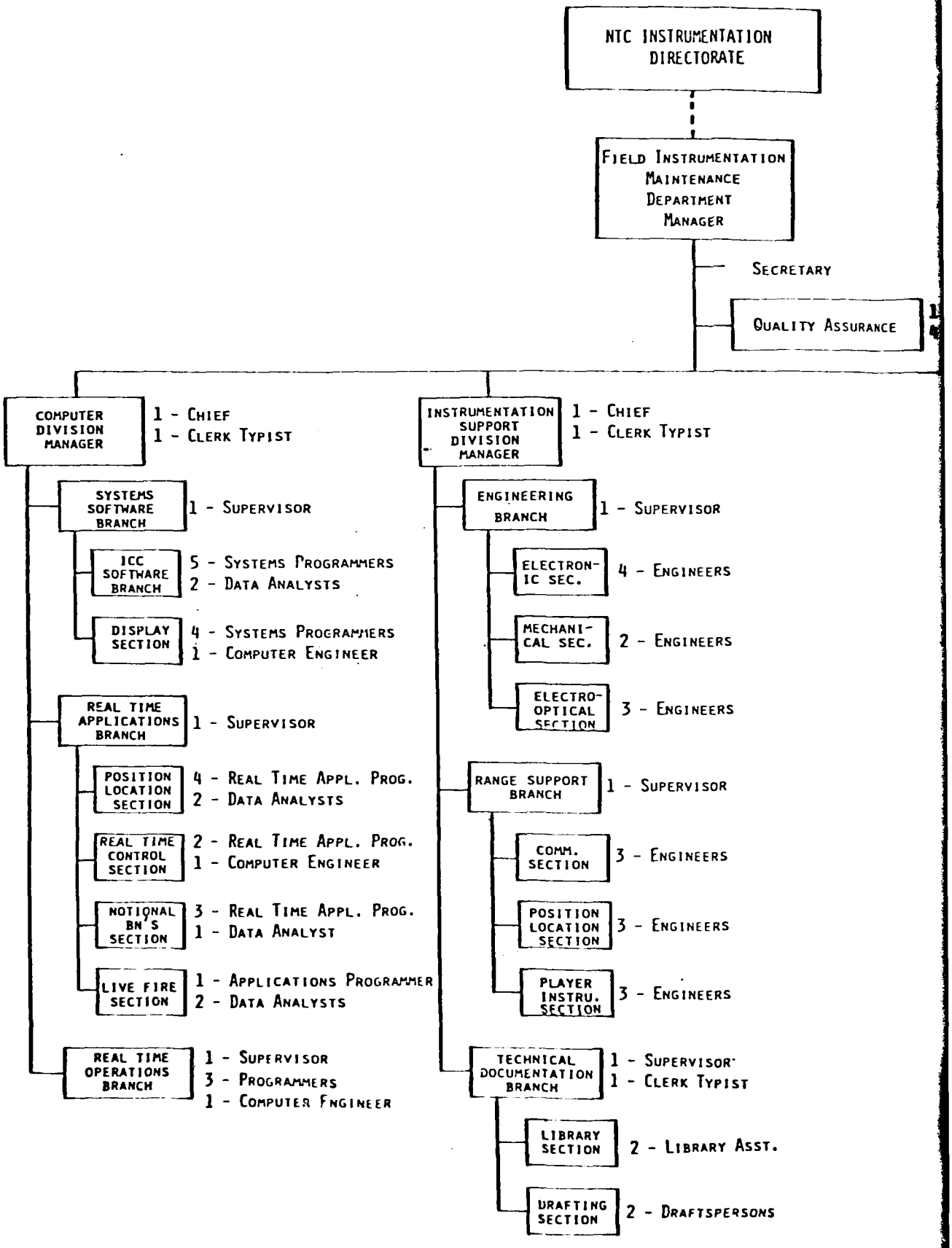
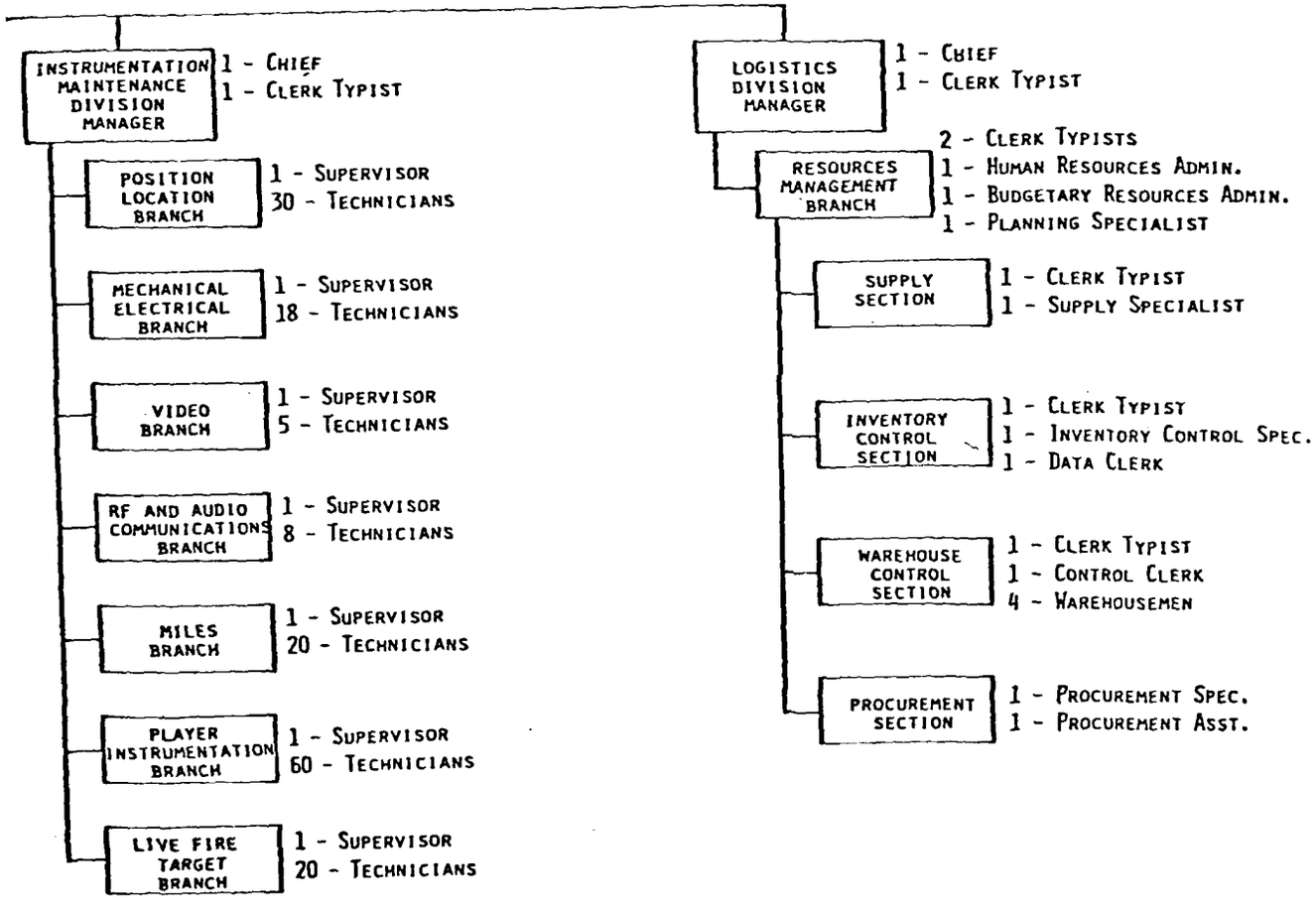


Figure 10. Field Instrumentation

1 - Manager
1 - Q/C Inspectors



Maintenance Support Organization

OPPORTUNITIES TO BE DERIVED FROM NTC 1A

- Summary

Opportunities To Be Derived From NTC 1A

SUMMARY

There are several opportunities from which useful information can be derived from NTC 1A for Phase I and II decision making.

Figure 11 summarizes the key opportunities to be derived from NTC 1A.

- There are two, essentially parallel, efforts involved in NTC 1A, Stages I-V. These involve the Core Instrumentation System Demonstration software, and CDEC NTC 1A Stage I ICC software and queueing model. Either, or both, can provide a base for Phase I software growth. The NTC 1A effort can form the foundation for Phase I hardware and software specification development.

  In addition, there is an opportunity to continue utilization of the NTC 1A Stage I hardware and software at CDEC, if Stages IV and V must be cancelled for any reason. This alternative could permit the continued development of ICC TAF/EMC operations utilizing scheduled CDEC experiments as the driving scenario (near term experiments include J-CATCH and ARMVAL).

- Human factors information can also be derived from any and all of the above, thus providing needed human factors insights into the EMC/TAF organization work loads, optimum display graphics and data display configurations, After Action Review formatting, etc.

  In addition, the identification of training activities which can or cannot be supported has direct implication on the hardware and software configuration and the cost for Phase I.

NTC 1A PROVIDES SOLID BASIS FOR PHASE I GROWTH

- CIS HARDWARE/SOFTWARE DEMONSTRATION
- NTC 1A STAGE I ICC
- HUMAN FACTORS INPUT
- IDENTIFICATION OF TRAINING ACTIVITIES WHICH CAN OR CANNOT BE SUPPORTED IN PHASE I
  - PROVIDES OPPORTUNITIES TO OPTIMIZE HARDWARE/SOFTWARE CONFIGURATION FOR PHASE I
  - PROVIDES OPPORTUNITY FOR PHASE I HARDWARE SPECIFICATION DEVELOPMENT
  - PROVIDES OPPORTUNITY FOR PHASE I SOFTWARE SPECIFICATION DEVELOPMENT

Figure 11. Opportunities To Be Derived From NTC 1A